Impacts of Industry 4.0 on Malaysian Manufacturing Industries

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Abstract: - Industry 4.0 is the fourth industrial revolution which is the new era to the world. However, there are not enough academic knowledge about it. Also, Malaysian manufacturing industries have not enough awareness of the impact of it. Hence, the objective of this research is to identify the main impacts of Industry 4.0 on manufacturing industries in Malaysia. This research is using a quantitative method of analysis, pairwise comparison, and the data collection method was questionnaires which answered by the experts of the Industry 4.0 in Malaysia. In the findings, the ranking in the results in order is flexibility, real-time detailed end-to-end product transparency and coordinating real time, etc. Therefore, based on the result of this study, the government can encourage manufacturing companies to implement Industry 4.0 and gain positive impacts.

Key-Words: - Industry 4.0, Manufacturing, Malaysia, Pairwise comparison, Main impacts, Flexibility.

1 Introduction

Manufacturing industries are important to the entire world because they transform the inputs into outputs which want to satisfy customers and meet their demands. Therefore, industries always improve their operation such as import some high technology machines and exchange workers to other developed countries to learn new technologies. Due to the continuous advancement of science, peoples live in the fast-growing world and peoples are developing new trends and technologies every day and integrating them into their daily lives [1]. When the industrial revolution occurred, the living standards, an economy of a country and other aspects were improved.

Now ushered the fourth industrial revolution as known as Industry 4.0 which is higher technologies, more productivity and less lead time. The emergence of Industry 4.0 was introduced to the world as a new trend to improve working surrounding in industries and solve the problem faced by industries. Industry 4.0 can be applied in operational implementation due to most of the research participants do not have a clear idea of how Industry 4.0 can use specific operations within the company [2].

Industry 4.0 is a well-known word but they are still not enough of the basic academic knowledge for this word [3]. So there is limited information about Industry 4.0 and not every people understand the real meaning of it. McKinsey had a survey with 300 manufacturing industries in January 2015 but only 48% from them consider to implement Industry 4.0 [4]. There are still fewer industries applying Industry 4.0. They know Industry 4.0 will bring advantages to a company but still not a very clear picture on the main impacts. Some of SMEs in Germany were less confident in the information security and data protection which will cause

Germany to leave behind the Industry 4.0 [5]. Some companies usually don't have enough manpower to look future and reject to enter new areas and not chance to invest in emerging technology as an early adaptor so that do not suffer losses due to focus on the wrong technology [6].

There still have the challenges for researchers and practice to develop the root causes and impacts of Industry 4.0 on production, business model and difference business functions [3].

Lee Wan Yee [7] recently has presented a list for impacts of industry 4.0 on manufacturing industries. Accordingly, Table 1 is presenting the list with the used references. Therefore, the objective of this research is to validate the list for Malaysian manufacturing industries and to identify the main impacts of Industry 4.0. Hence, with reference to table 1 as an input, this research will be carried out with the experts of Industry 4.0.

Table 1. The Impacts of Industry 4.0 on Manufacturing industries

Code	Impacts	Reference
I 1	Accomplishing high wage economy	[8]
I 2	Achieving individual customer requirements	[8]
I 3	Autonomous controlling	[9][
I 4	Backup system in cloud storage more safer and reliable	[9]
I 5	Coordinating real time	[10]
I 6	Creating value opportunities	[8] [10]
I 7	Demographic of workplace will change	[8] [11]
I 8	Developing a powerful data security environment	[9]

the use of a scale of 1 to 9 [18, 19]. The respondents were the experts of Industry 4.0 who are recognized by Ministry of International Trade and Industry (MITI) of Malaysia.

The mathematical pairwise comparison was utilized after collecting the response from the experts to analyze the impacts of Industry 4.0. This methodology is adapted from research by Sorooshian and Ting [20].

The beginning of the analysis is with calculating the average of responses. For the average calculation is using Microsoft Excel which is "Average" formula. The formula for calculating average is shown with equation 1.

$$\bar{x} = \frac{\sum x}{n} \qquad (1)$$

Next step is calculating the standardization of each criterion. This is the main step for pairwise

Code	Impacts	Reference
I 9	Flexibility	[8] [9]
I 10	Forming business models evolution	[12][10]
I 11	Forming proactive maintenance	[13]
I 12	Forming smart factory	[14][14]
I 13	Gaining financial benefits	[14]
I 14	Improving energy consumption more efficient	[9]
I 15	Improving mass customization	[13]
I 16	Improving safety and reliability in operation	[15]
I 17	Improving the efficiency of the production processes	[16]
I 18	Increasing productivity	[17]
I 19	Increasing revenue growth	[17]
I 20	Leading to innovation	[9]
I 21	Mass production becomes highly flexible	[10]
I 22	Optimizing decision making	[8]
I 23	Optimizing in procurement process	[16]
I 24	Precise Risk management	[10]
I 25	Real time detailed end-to-end product transparency	[9] [16][10]
I 26	Reducing costs	[16] [10]
I 27	Resources become more productivity and efficient	[8] [11][9]
I 28	Value chains optimized	[10] [11]
I 29	Work-life-balance	[8]

2 Methodology

A questionnaire was carried out through face-to-face distribution and emailing to the respondents. The questionnaire divided into 2 parts which are part A and part B. Part A is the respondents' demography and part B is the pairwise comparison matrix. Pairwise comparison is comparing the criteria with

comparison because this step is to prioritize the impacts. So the priority vector or weight will be calculated as to achieve the objective of the research. The formula for normalization is shown as equation 2 [21,22]:

$$\sum_{i=1}^{n} \frac{cell\ value\ i}{column\ sum\ i} \qquad (2)$$

3 Result

The list and contact information of the experts was provided by MITI. Invited experts were 16 people and only 11 people were responded to this research. All the respondents are working more than 9 years in Malaysian industries. The expert's demography is tabulated in table 2 to table 4.

Table 2. Gender

Gender	Frequency	Percentage (%)
Male	8	72.73
Female	3	27.27
Total	11	100.00

Table 3. Age

Age	Frequency	Percentage (%)
<30	-	-
30-39	-	-
40-49	3	27.27
50-59	7	63.64
60-69	1	9.09
>69	-	-
Total	11	100.00

Table 4. Educational Level

Educational Level	Frequency	Percentage (%)
Secondary	-	-
Diploma	-	-
Degree	3	27.27
Master	6	54.55
PhD	2	18.18
Total	11	100.00

After data collection pairwise comparison implemented by its applying mathematical approach to calculating the priority vector. The average of the 9-scale answers to the questionnaires by the experts are used for further calculations.

Ranking for the impacts achieves the objective of this survey. Based on equation 2, the ranking for the impacts from the lowest priority to the highest priority, with reference to the Priority Vector, is shown in Fig 1.

Figure 1. Level for the Impacts

Impact	Priority Vector (%)
I1	1,90%
I..	1,93%
I..	2,03%
I..	2,04%
I..	2,35%
I..	2,37%
I..	2,38%
I..	2,45%
I..	2,47%
I 6	2,47%
I 7	2,55%
I..	2,57%
I 2	2,71%
I..	2,81%
I..	2,85%
I..	2,86%
I..	2,94%
I..	3,03%
I..	3,08%
I..	3,45%
I 4	3,83%
I 8	3,93%
I..	4,06%
I..	4,39%
I..	4,66%
I 3	6,33%
I 5	6,65%
I..	6,66%
I 9	8,26%
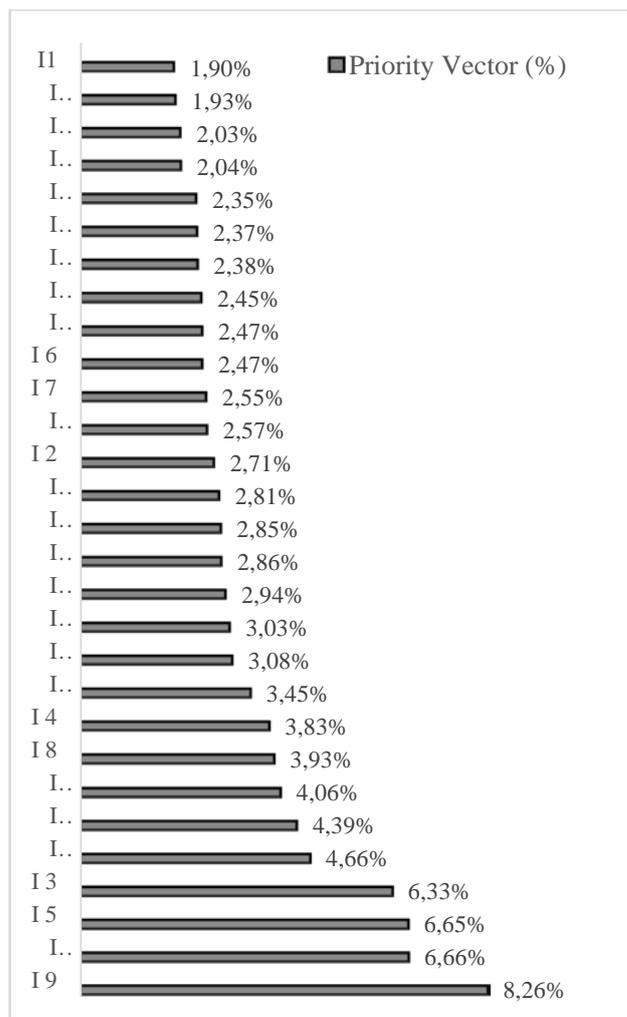
From the result of this study, flexibility (I9) gets the highest score which is the most important impact in Industry 4.0 on manufacturing industries in Malaysia with the priority vector of 0.0826 or 8.26%. They mentioned that Industry 4.0 will assist industry more flexibility because CPS-based ad hoc network can configure dynamically in various business process area such as price, robustness, risk, time, quality and environmental protection [8]. So this means flexibility can be covered to different conditions such as flexible machines [17] and the flexible working time [23].

The following main impact is real-time detailed end-to-end product transparency (I25) which get the 0.0666 or 6.66%. It also can help to trace material flow in real time [10]. At the same time, the customers can know the actual condition for their goods. Based on Schreiber [24], the responsiveness of the whole supply chain including design, manufacturing, quantity, rework, and life-long service regulations have been improved.

Ranking 3 is coordinating real time and its priority vector is 0.0665 or 6.65%. If the process or action changes, the worker or machine must wait

until manual transmission of instructions or loading data into the production system [25]. Khan & Turowski [25] stated that machines or people carry out their work quicker according to present data then feedback from an employee is very positive and the overall activities has been optimized because of the immediate availability data.

For the rank 4 is autonomous controlling 0.0633 or 6.33%. Autonomous controlling can replace the low-skilled workers who working easy and monotonous [17]. Therefore, ranking 5 is optimizing decision making which is 0.0466 or 4.66%. Because of Industry 4.0 gives end-to-end transparency so the design engineering can be verified early and will provide response flexibility to disruptions and global optimization of production sites for all companies [8]. Ranking 6 is improving safety and reliability in operation which is 0.0439 or 4.39%. Because of Industry 4.0 will use less of manpower and this will ensure their safety. Ranking 7 is forming a smart factory which is 0.0406 or 4.06%. The smart factory is a special application of CPS which is realized based on the extensive and in-depth implementation of information technology information in the manufacturing industry [26].

4 Conclusion

Industry 4.0 is a new trend to the world as to improve working surrounding in industries but there are problems: There is limited information about Industry 4.0 and not every people understand the real impact of Industry 4.0. Besides, some industries are lack of awareness to implement Industry 4.0. According to this research, the manufacturing industries and Malaysian government will get advantages as they can understand the main impacts of Industry 4.0. The industries need to understand the impacts of Industry 4.0 and the government can refer to this research to give encouragement to the industries as implementing Industry 4.0. This research will be an advantage for the government and industries. With reference to this research, the government has a valid reference to encourage more industries to adopt Industry 4.0.

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